

# GFF Data Extensions

Sandia National Laboratories  
Albuquerque, NM 87185-0519

REVISION W     8/14/2014



**Sandia National Laboratories**



**U.S. DEPARTMENT OF  
ENERGY**

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

This page intentionally left blank.

## Revision History

Date	Rev.	Description	Author
2-20-08	A	Creation	JM/TB
5-7-08	B	Added units column to tables, added velDown, velEast, velNorth, passNumber, and imageNumber to RADARINFO structure, and changed "imageMode" to "radarMode"	TB
5-9-08	C	Added int type to Image formation autoFocusInfo variable. Also changed PHP title to Image Formation.	JM
6-14-08	D	Renamed gimStopInner, Mid and outer to gimStopTwist, Tilt and Az	JM
7-02-08	E	Cleaned and matched with code, also changed rxPolarization and txPolarization to enums to match NITF format.	JM
8-26-08	F	Changed rxAtten and txAtten to floats from ints	JM
12-10-09	G	Added the following: apfdFactor to aperture info extension. rngFFTSIZE, RangPaneFilterCoeff and AzPreFilterCoeff values to Image Formation extension. HPFMeanSource, IChanMean and QChanMean to RADAR extension	JM
2-16-10	H	Added the following to Momeas extension: receiverKeyed, differentialCorrection, P1_std, P2_std, P3_std, V1_std, V2_std, V3_std	JM
4-6-10	I	Added the following to Aperture extension: rngSamples, adSampleFreq, apertureTime, azPulses	JM
5-25-10	J	Made missionText and swVersion fields larger, went from 8 chars to 50 chars each. Added gpsReceiverUsed to documentation. Added radarMode values to comments.	JM
3-31-11	K	Added lightSpeed to Aperture extension	JM
9-2-11	L	Bumped Geo and IF extension minor rev numbers. The pixLocImCtrRow and pixLocImCtrCol in GEO and sampLocDCRow and sampLocDCCol in the IF info were reversed and were fixed in the current version of these extensions.	JM
12-12-11	M	Added new extensions for CCD and Compress.	LP
6-1-12	N	Added new extensions for Chip Information and Multi-Look Information. Added enum values for procProduct in Image Formation Information and	AS

		phSource in Aperture Information.	
6-15-12	O	Changed procProduct to an int so it can be an enum in the code.	JM
8-16-12	P	Added MULTI_RES_VIDEO_SAR to radarMode	JM
11-30-12	Q	Added AFPeakQuadComp to Image formation extension	JM
6-20-13	R	Updated naming information for RADARINFO	NME
4-09-14	S	Updated CCDINFO and COMPRESSINFO to v1.1,also added the “phantom” pointers that exist in all extension header blocks	HJC
4-09-14	T	Added the SMDINFO extension and provided information on the variable length base class that it uses.	LZP
6-5-14	U	Added a fixed length struct to SMDINFO. Added new field to APINFO. Corrected the IFINFO version number and size.	LZP
8-05-14	V	Removed OUO/ECI markings. Changed APINFO flightTime to “since midnight Sunday”, same for CCDINFO flightTimeRef1 and flightTimeRef2; added TRACKINFO extension.	NLS
8-13-14	W	Added Sandia and DOE logos; added Sandia funding statement.	NLS

## Table of Contents

---

REVISION HISTORY .....	2
TABLE OF CONTENTS.....	4
ACRONYMS AND TERMS.....	5
1 INTRODUCTION.....	6
1.1 PURPOSE .....	6
1.2 SCOPE .....	6
2 GFF HEADER EXTENSIONS.....	7
3 IMAGE GEOGRAPHIC INFORMATION .....	8
4 APERTURE INFORMATION .....	10
5 IMAGE FORMATION INFORMATION.....	14
6 GMTI INFORMATION .....	17
7 RADAR INFORMATION .....	18
8 MOTION MEASUREMENT INFORMATION.....	20
9 CCD INFORMATION.....	22
10 COMPRESS INFORMATION.....	24
11 CHIP INFORMATION .....	25
12 MULTI-LOOK INFORMATION .....	26
13 VARIABLE LENGTH BASE CLASS.....	27
14 SMALL MOVER DETECT INFORMATION .....	29
15 FUTURE HEADER EXTENSIONS.....	31

## **Acronyms and Terms**

---

<b>Acronym</b>	Description
<b>SAR</b>	Synthetic Aperture Radar
<b>GSAT</b>	Ground-based SAR Applications Test bed
<b>GFF</b>	GSAT File Format
<b>HPF</b>	High Pass Filter

# **1 Introduction**

---

## **1.1 Purpose**

To identify GFF extensions needed to provide metadata to the basic GFF structure.

## **1.2 Scope**

To define the GFF extension and the data contained in the extension.

## **2 GFF Header Extensions**

---

Header extensions as defined in the GFF Spec are bound by the GFF common tag structure with the data defined in the blocks that follow.

GFF readers should be designed with future expansion in mind. For example, a GFF reader should not assume that a particular header extension will only have a specific set of variables forever. It should read the information in the header extension that it knows about and then jump to the next header extension by comparing its current file position with the number of bytes in the header extension.

If backwards compatibility is ever broken for a header extension, the major version number in the common tag structure preceding the header extension must be incremented.

GFF file readers should skip over any unknown header extensions by using the information in the common tag structure preceding the header extension.

The initial list of header extensions is based on what is use today. IFSAR is not currently used so no attempt was made to define an IFSAR specific header extension.



### 3 Image Geographic Information

---

The header extension contains the information needed to properly geo-locate every pixel in the image.

**Table 1. Values of the Common Tag Structure for the Image Geographic header extension.**

Field name	Default	Comments
systemID	"GEOINFO"	Tag identifying this extension
versMajor	1	Main header major version
versMinor	1	Main header minor version
p_data	0	Unused
numBytes	52	The size of the geo information structure. sizeof(GeoInfo_t)
p_next	0	Unused

**Table 2. Contents of the Image Geographic header extension.**

Field name	Type	Elements	Units	Description
imagePlane	int32	1	n/a	Ground(0) vs Slant(1) plane
rangePixSpacing	float	1	m	The range pixel spacing in the specified plane
desiredGrazAng	float	1	deg	Nominal grazing angle  This is the grazing angle that corresponds to the reported range pixel spacing (rangePixSpacing). The imagery has been corrected using a flat-earth model to look as if it was collected with these parameters. In other words, use these values together to most easily compute positions from the imagery.
azPixSpacing	float	1	m	Azimuth pixel spacing
patchCtrLat	double	1	deg	WGS-84
patchCtrLong	double	1	deg	WGS-84
patchCtrAlt	double	1	m	WGS-84, HAE
pixLocImCtrRow	unsigned int	1	n/a	Row index of the pixel whose coordinates are given by patchCtrLat, patchCtrLong and patchCtrAlt. Pixel (0,0) is the upper left corner of the image.
pixLocImCtrCol	unsigned int	1	n/a	Column index of the pixel whose coordinates are given by patchCtrLat, patchCtrLong and patchCtrAlt. Pixel (0,0) is the upper left corner of the image.
imgRotAngle	float	1	deg	The angle that a column of pixels makes with respect to True North at the patch center point.

## 4 Aperture Information

This sub header contains information about the aperture of phase histories from which the image was formed.

**Table 3. Values of the Common Tag Structure for the Aperture header extension.**

Field name	Default	Comments
systemID	“APINFO”	Tag identifying this extension
versMajor	5	Main header major version
versMinor	2	Main header minor version
p_data	0	Unused
numBytes	434	The size of the aperture information structure. sizeof(ApInfo_t)
p_next	0	Unused

**Table 4. Contents of the Aperture header extension.**

Field name	Type	Elements	Units	Description
missionText	char	50	n/a	Contains the mission text that the radar operator entered to start the pass that formed this image.
swVerNum	char	50	n/a	Version number of the software used to collect and form this image.
radarSerNum	unsigned int	1	n/a	Serial number of the radar that collected and formed this image.
phSource	unsigned int	1	n/a	Source of the phase history data. 0 = channel 0 1 = channel 1
phNameLen	unsigned short	1	n/a	Length of the phase history name string in bytes.
phName	char	128	n/a	Name of the file that contains the phase history dataset used to form this image.
ctrFreq	float	1	Hz	Nominal operating center frequency in Hz.
wavelength	float	1	m	Actual wavelength at the center of aperture, including the cosine depression and alpha, etc. adjustments to the center frequency.
rxPolarization	enum (int)	1	n/a	The receive polarization H – Horizontal (0) V – Vertical (1) L – Left circular (2) R – Right circular (3) T – Theta (4) P – Phi (5)
txPolarization	enum (int)	1	n/a	The transmit polarization H – Horizontal (0) V – Vertical (1) L – Left circular (2) R – Right circular (3) T – Theta (4) P – Phi (5)

Field name	Type	Elements	Units	Description
azBeamWidth	float	1	deg	One-way principle-cut 3dB azimuth beamwidth
elBeamWidth	float	1	deg	One-way principle-cut 3dB elevation beamwidth.
grazingAngle	float	1	deg	Measured grazing angle at the middle of the aperture
squintAngle	float	1	deg	Measured squint angle at the middle of the aperture
gta	float	1	deg	Measured ground track angle at the middle of the aperture. This the angle of the true velocity vector measured in a horizontal plane with respect to True North.
rngToBeamCtr	float	1	m	Measured range to the patch center point at the middle of the aperture.
desSquint	float	1	deg	Desired squint angle at the middle of the aperture.
desRng	float	1	m	Desired range to the patch center point at the middle of the aperture.
desGTA	float	1	deg	Desired angle of the antenna velocity vector at the middle of the aperture with respect to True North.
antPhaseCtrBear	float	1	deg	Azimuthal direction from the patch center point to the antenna location at the center of the aperture. This angle is measured with respect to True North in a clockwise direction.
yearMidAp	unsigned short	1	n/a	Time at the middle of the aperture
monthMidAp	unsigned short	1	n/a	“
dayMidAp	unsigned short	1	n/a	“
hourMidAp	unsigned short	1	n/a	“
minuteMidAp	unsigned short	1	n/a	“
secondMidAp	unsigned short	1	n/a	“
flightTime	unsigned int	1	ms	Milliseconds since midnight Sunday GMT at the middle of the aperture.
flightWeek	unsigned int	1	n/a	GPS week number at the middle of the aperture.
chirpRate	float	1	Hz/sec	Nominal chirp rate at the middle of the aperture. This value does not include the cosine grazing adjustments.
xDistToStart	float	1	m	X distance to start at mid aperture.
momeasMode	unsigned int	1	n/a	Motion compensation mode: a value of 4 indicates motion compensation to a line and a value of 5 indicates motion compensation to

Field name	Type	Elements	Units	Description
				a point.
radarMode	unsigned int	1	n/a	Indicates the type of pass of which this image was a part (SpotLight, StripMap, Tracking, etc.) SPOTLIGHT = 0, STRIPMAP = 1, CIRCLE = 2, TRACKING = 3, SPOTDWELL = 4, PH_CIRCLE = 5, PH_LINE = 6, WIDE_AREA_SEARCH = 7, SPOT_SEARCH_GMTI = 8, STARING_AND_TARGET_TRACKING_GMTI = 9, HIGH_PRF_CONTINUOUS_COLLECT= 10, SPOTLIST=11, MULTI_RES_VIDEO_SAR = 12
rfoa	float	1	deg	Angle of the x-axis of the radar coordinate frame with respect to True North.
xVel	double	1	m/s	Velocity of the antenna phase center parallel to the x-axis of the radar coordinate frame at the center of the aperture.
yVel	double	1	m/s	Velocity of the antenna phase center parallel to the y-axis of the radar coordinate frame at the center of the aperture.
zVel	double	1	m/s	Velocity of the antenna phase center parallel to the z-axis of the radar coordinate frame at the center of the aperture.
apcLat	double	1	deg	WGS-84 location of the antenna phase center at the center of the aperture.
apcLon	double	1	deg	“
apcAlt	double	1	deg	“
keepOutViol	float	1	%	Percentage of the aperture that the antenna was in position where the patch might not have been fully illuminated.
gimStopTwist	float	1	%	Percentage of the aperture that the antenna was against the inner gimbal stop.
gimStopTilt	float	1	%	Percentage of the aperture that the antenna was against the middle gimbal stop.
gimbalStopAz	float	1	%	Percentage of the aperture that the antenna was against the outer gimbal stop.
apfdFactor	int	1	n/a	Azimuth prefilter decimation factor.
fastTimeSamples	unsigned int	1	n/a	Number of range samples.
adSampleFreq	float	1	Hz	Analog to Digital converter sample frequency.
apertureTime	float	1	Seconds	Length of the synthetic aperture in seconds computed as (time of the last phase history sample) - (time of the first phase history

Field name	Type	Elements	Units	Description
				sample)
numPhaseHistories	unsigned int	1	n/a	Number of phase histories used in forming the image
lightSpeed	double	1	n/a	Speed of light with which this data was processed.
delTanApAngle	Float	1	n/a	Difference in the tangent of the aperture angle (the angle in the ground plane between the aperture-center radar-to-patch vector and the current radar-to-patch vector) from one pulse to the next
metersInSampleDoppler	Float	1	m	The number of meters in azimuth at the patch center that are covered by the Nyquist azimuth sampling.

## 5 Image Formation Information

This header extension contains information about the phase history processing used to form this image.

**Table 5. Values of the Common Tag Structure for the Phase History Processing header extension.**

Field name	Default	Comments
systemID	"IFINFO"	Tag identifying this extension
versMajor	3	Main header major version
versMinor	0	Main header minor version
p_data	0	Unused
numBytes	586	The size of the geo information structure. sizeof(IfInfo_t)
p_next	0	Unused

Table 6. Contents of the Phase History Processing header extension.

Field name	Type	Elements	Units	Description
procProduct	int	1	n/a	What type of processing created this product 0 = Unknown 1 = SAR 2 = GMTI 3 = CCD 4 = NCP 5 = MCD 6 = Multi-look
imgFileNameLen	unsigned short	1	n/a	
imgFileName	char	128	n/a	Name of the GFF file
azResolution	float	1	m	Operator desired azimuth resolution at the far range.
rngResolution	float	1	m	Operator desired slant-range resolution.
imgCalParam	float	1		Image amplitude calibration scale factor. This value is used to compute the radar cross-section of a pixel.
sigmaN	float	1	dB	Actual noise equivalent cross section based on the measured transmitter power.
sampLocDCRow	int	1	n/a	Sample location of DC (zero frequency) in the row dimension in the spatial frequency domain for the 2-D FFT of the patch.
sampLocDCCol	int	1	n/a	Sample location of DC (zero frequency) in the column dimension in the spatial frequency domain for the 2-D FFT of the patch.
ifAlgo	char	8	n/a	Algorithm that generated this image. Possible values include “OSA”, “OSAPF”, “PF”, “2DFFT”.
imgFlag	int	1	n/a	Flags that provide information about the processing of the images, e.g., which amplitude corrections were turned on, was tangent alpha used, etc.
azCoeff	float	6	n/a	Azimuth antenna pattern curve fit coefficients
elCoeff	float	9	n/a	Elevation antenna pattern curve fit coefficients
azGeoCorrect	int	1	n/a	The geometric corrections applied to the image in azimuth.
rngGeoCorrect	int	1	n/a	The geometric corrections applied to the image in range.
wndBwFactAz	float	1	n/a	The -3 dB relative bandwidth for the azimuth window used, e.g. -35 dB Taylor window (nbar = 4) would supply a value of 1.184.
wndBwFactRng	float	1	n/a	The -3 dB relative bandwidth for the range window used, e.g. -35 dB Taylor



				window (nbar = 4) would supply a value of 1.184.
wndFnclAz	char	48	n/a	The windowing function applied to this image in azimuth.
wndFnclRng	char	48	n/a	The windowing function applied to this image in range.
cmtLen	unsigned short	1	n/a	
cmtText	char	166	n/a	Arbitrary user defined comment
autoFocusInfo	int	1	n/a	Autofocus algorithm applied to this image. 0 – No autofocus 1 – Sub aperture (OSAPF only) 2 – Post imaging 4 – Spatially Variant 8 – Post imaging (Modified point select and PGA)
rngFFTSIZE	int	1	n/a	Size of range fft applied
RangePaneFilterCoeff	float	11	n/a	Range pane filter coefficients for curve fit.
AzPreFilterCoeff	float	5	n/a	Azimuth pre filter coefficients for curve fit.
AFPeakQuadComp	float	1	degrees	Peak quadratic component used in Autofocus vector. ( $y=A * x^2$ where $y = \text{AFPeakQuadComp}$ )

## 6 GMTI Information

This header extension contains information specific to the GMTI images.

**Table 7. Values of the Common Tag Structure for the GMTI header extension.**

Field name	Default	Comments
systemID	“GMTIINFO”	Tag identifying this extension
versMajor	1	Main header major version
versMinor	0	Main header minor version
p_data	0	Unused
numBytes	8	The size of the gmti information structure. sizeof(GmtiInfo_t)
p_next	0	Unused

**Table 8. Contents of the GMTI header extension.**

Field name	Type	Elements	Units	Description
mti_calmin	float	1		
mti_calscale	float	1		

## 7 Radar Information

This sub-header contains information specific to the radar. These parameters are used primarily in debugging the radar.

**Table 9. Values of the Common Tag Structure for the RADAR header extension.**

Field name	Default	Comments
systemID	“RADARINFO”	Tag identifying this extension
versMajor	2	Main header major version
versMinor	0	Main header minor version
p_data	0	Unused
numBytes	64	The size of the geo information structure. sizeof(RadarInfo_t)
p_next	0	Unused

**Table 10. Contents of the RADAR header extension.**

Field name	Type	Elements	Units	Description
phDataRecorded	unsigned int	1	n/a	Was phase history data recorded for this aperture?
tapeBlockLogAddr	unsigned int	1	n/a	JBOD address of the phase history data if it was recorded on a JBOD.
rxatten	float	1	dB	RX attenuator value for this aperture.
rx_gain	float	1	dB	Measured RX gain for this aperture.
txatten	float	1	dB	TX attenuator value for this aperture.
tx_power	float	1	watts	Value of transmitter power used in the sigmaN calculation for this aperture.
tx_power_source	int	1	n/a	Source of tx_power (measured, table, user specified)
sugg_tx_pwr	float	1	watts	Transmitter power required to give the desired value of sigmaN.
velDown	float	1	m/s	Down velocity of the antenna phase center in the ECEF coordinate frame at the center of the aperture.
velEast	float	1	m/s	East velocity of the antenna phase center in the ECEF coordinate frame at the center of the aperture.
velNorth	float	1	m/s	North velocity of the

				antenna phase center in the ECEF coordinate frame at the center of the aperture.
passNumber	int	1	n/a	
imageNumber	int	1	n/a	
HPFMeanSource	int	1	n/a	0 – use mean values specified by Host 1 – use mean value calculated by HPF 2 – use mean value from by RX gain calculation
IChanMean	float	1	Counts	Mean value used by the HPF for the I-channel
QChanMean	float	1	Counts	Mean value used by the HPF for the Q-channel

## 8 Motion Measurement information

This header-extension contains detailed information on Motion Measurement.

**Table 11. Values of the Common Tag Structure for the Motion Measurement header extension.**

Field name	Default	Comments
systemID	"MOMEASINFO"	Tag identifying this extension
versMajor	2	Main header major version
versMinor	0	Main header minor version
p_data	0	Unused
numBytes	16	The size of the geo information structure. sizeof(MomeasInfo_t)
p_next	0	Unused

**Table 12. Contents of the Motion Measurement header extension.**

Field name	Type	Elements	Units	Description
posUncertDown	float	1	m	A 1 sigma value of expected position error in the down direction.
posUncertE	float	1	m	A 1 sigma value of expected position error in the East direction.
posUncertN	float	1	m	A 1 sigma value of expected position error in the North direction.
navAidingType	int	1	n/a	Specifies whether the inertial navigation solution was aided with GPS, or DGPS, and if so, to what level of accuracy during this aperture. 0 GPS not available & no GPS aiding 1 non-diff. GPS available, but measurements skipped, no GPS aiding 2 diff. available, but measurements skipped, no GPS aiding 3 non-diff. GPS aided (> 5 meter accuracy) 4 diff. GPS aided (> 2 meter accuracy) 5 diff. GPS aided (1 to 2 meter accuracy) 6 diff. GPS aided (0 to

				1 meter accuracy)
gpsReceiverUsed	int	1	n/a	GPS receiver used: NONE = 0, STARFIRE = 1, GBGRAM = 2, NOVATEL = 3
receiverKeyed	int (boolean)	3	n/a	Boolean value indicating if receiver is keyed. 0 – not keyed 1 - keyed
differentialCorrection	int (boolean)	3	n/a	Boolean value indicating if differential correction is applied. 0 – not applied 1 – applied
P1_std	double	1		Position coordinate 1 standard deviation
P2_std	double	1		Position coordinate 2 standard deviation
P3_std	double	1		Position coordinate 3 standard deviation
V1_std	double	1		Velocity coordinate 1 standard deviation
V2_std	double	1		Velocity coordinate 2 standard deviation
V3_std	double	1		Velocity coordinate 3 standard deviation

## 9 CCD Information

This header extension contains information specific to the CCD/NCP images.

**Table 13, Values of the Common Tag Structure for the CCD header extension.**

Field name	Default	Comments
systemID	“CCDINFO”	Tag identifying this extension
versMajor	1	Main header major version
versMinor	1	Main header minor version
p_data	0	Unused
numBytes	552	The size of the ccd information structure. sizeof(CcdInfo_t)
p_next	0	Unused

**Table 14, Contents of the CCD header extension.**

Field name	Type	Elements	Units	Description
avgCoherence	float	1	n/a	Average coherence for CCD.
bulkRegX	float	1	n/a	Bulk registration shift in the x-axis.
bulkRegY	float	1	n/a	Bulk registration shift in the y-axis.
flightTimeRef1	unsigned int	1	n/a	Milliseconds since midnight Sunday GMT at the middle of the aperture for first reference.
flightTimeRef2	unsigned int	1	n/a	Milliseconds since midnight Sunday GMT at the middle of the aperture for second reference.
flightWeekRef1	unsigned int	1	n/a	GPS week number at the middle of the aperture for first reference.
flightWeekRef2	unsigned int	1	n/a	GPS week number at the middle of the aperture for second reference.
ref1FileNameLen	unsigned short	1	n/a	
ref2FileNameLen	unsigned short	1	n/a	

ref1FileName	char	256	n/a	Name of the first reference GFF file
ref2FileName	char	256	n/a	Name of the second reference GFF file
origRangePixels	unsigned int	1	n/a	Number of range pixels before reg/warp crop
origAzPixels	unsigned int	1	n/a	Number of azimuth pixels before reg/warp crop



## 10 Compress Information

This header extension contains information specific to the compressed images.

**Table 15, Values of the Common Tag Structure for the Compress header extension.**

Field name	Default	Comments
systemID	“COMPRESSINFO”	Tag identifying this extension
versMajor	1	Main header major version
versMinor	1	Main header minor version
p_data	0	Unused
numBytes	20	The size of the compress information structure. sizeof(CompressInfo_t)
p_next	0	Unused

**Table 16, Contents of the Compress header extension.**

Field name	Type	Elements	Units	Description
uncompressedSize	int	1	n/a	Size of the uncompressed image. The main header stores the compressed size.
compressionVal	float	1	n/a	This represents the quality setting (JPEG) or the compression ratio (JPEG2000)
jpegLUT	unsigned int	1	n/a	(Can be used for non-JPEG applications) Stores the LUT that was applied to the image dat.
jpegOffset	unsigned int	1	n/a	(Can be used for non-JPEG applications) Stores the offset that was applied to the image data
suggestedLUT	float	1	n/a	Suggested LUT for the viewing application to apply

## 11 Chip Information

This header extension contains information specific to Chips extracted from larger images.

**Table 17, Values of the Common Tag Structure for the Chip header extension.**

Field name	Default	Comments
systemID	“CHIPINFO”	Tag identifying this extension
versMajor	1	Main header major version
versMinor	0	Main header minor version
p_data	0	Unused
numBytes	44	The size of the chip information structure. sizeof(ChipInfo_t)
p_next	0	Unused

**Table 18, Contents of the Chip header extension.**

Field name	Type	Elements	Units	Description
zoomLevel	float	1	n/a	Zoom level of chip {1x, 1.5x, 2x}
MCPLat	double	1	deg	WGS-84
MCPLon	double	1	deg	WGS-84
MCPAlt	double	1	m	WGS-84, HAE
chipUpperLeftCorner_x	unsigned int	1	n/a	Column number of the upper left corner pixel in the original image from where the chip was cut
chipUpperLeftCorner_y	unsigned int	1	n/a	Row number of the upper left corner pixel in the original image from where the chip was cut
rangePixels_original	unsigned int	1	n/a	Number of range pixels in the original image
azPixels_original	unsigned int	1	n/a	Number of azimuth pixels in the original image

## 12 Multi-Look Information

This header extension contains information specific to composite multi-look images.

**Table 19, Values of the Common Tag Structure for the Multi-look header extension.**

Field name	Default	Comments
systemID	"MULTILOOKINFO"	Tag identifying this extension
versMajor	1	Main header major version
versMinor	0	Main header minor version
p_data	0	Unused
numBytes	208	The size of the chip information structure. sizeof(ChipInfo_t)
p_next	0	Unused

**Table 20, Contents of the Multi-look header extension.**

Field name	Type	Elements	Units	Description
method	enum (int)	1	n/a	Algorithm used to generate the multi-look image. {1=linear average}
numberOfImages	unsigned int	1	n/a	Number of SAR images used to create the multi-look image.
APB0	float	1-50	deg	Azimuthal direction from the patch center point to the antenna location at the center of <i>each</i> aperture used to construct the multilook image. This angle is measured with respect to True North in a clockwise direction.

## 13 Variable Length Base Class

In addition to the fixed length extensions, GFF2.0 supports variable length extensions. The base class will only modify the numBytes bytes field in the common tag structure. This will ensure a reader can skip over the extension properly if it does not read it. The first 4 bytes give the number of variable length variables in the class. The next 12 bytes in a variable length extension will contain the struct GffVarLenData\_t that indicates how the data is stored (for the first variable). If there are multiple variable length variables, all the GffVarLenData\_t structs will be stored consecutively. Comment on the numBytes field in the common tag structure: value in the field must equal  $4 + n * 12 + \text{numElements}(1) * \text{elementSize}(1) + \dots + \text{numElements}(n) * \text{elementSize}(n)$ .

**Table 21, Contents of the Variable length header struct GffVarLenData\_t**

Field name	Type	Elements	Units	Description
eVarLenType	enum (int)	1	n/a	The data type of each element: eNONE = 0, eUC8 = 1, eC8 = 2, eUS16 = 3, eS16 = 4, eUI32 = 5, eI32 = 6, eUL64 = 7, eL64 = 8, eF32 = 9, eD64 = 10, eSTRUCT = 11
numElements	unsigned int	1	n/a	Number of elements in the extension
elementSize	unsigned int	1	n/a	The size of each element in the array. This is used to support struct as an element type.

**Table 22, Organization of the Variable length header and data**

Field name	Type	Elements	Description
NumVariables	n/a	1	Number of variable length variables
VarHeader	GffVarLenData_t	NumVariables	Description of how each variable is stored. All the structs are stored consecutively
VarData (1)	VarHeader(1) > eVarLenType	VarHeader(1) > numElements	There is no byte that indicates the

			variable has ended. Go by size alone.
...	...	...	...
VarData(n)	VarHeader(n) > eVarLenType	VarHeader(n) > numElements	

## 14 Small Mover Detect Information

This header extension contains information specific to images that had the small mover detect algorithm ran on it. This is a variable length extension.

**Table 23, Values of the Common Tag Structure for the Small Mover Detect header extension.**

Field name	Default	Comments
systemID	“SMDINFO”	Tag identifying this extension
versMajor	1	Main header major version
versMinor	0	Main header minor version
p_data	0	Unused
numBytes	16 + 17*numElements	The equation for the size of the smd information structure. 16 is the variable length header size and sizeof(GFFHeaderSmdElements_t) = 17
p_next	0	Unused

**Table 24, Values of the Fixed Length Structure for the SMD extension GFFHeaderSmdInfo.**

Field name	Type	Elements	Units	Description
smdBoxRotAngle	Float	1	deg	Angle relative to the current pixel grid that the SMD boxes should be drawn. If non-zero, the indices in the elements struct must be rotated by this field.

**Table 255, Values of the Variable Length Structure for the Small Mover Detect header extension.**

Field name	Default	Comments
eVarLenType	eSTRUCT	
elementSize	17	sizeof(GFFHeaderSmdElements_t)

**Table 266, Contents of the Small Mover Detect header extension GFFHeaderSmdElements.**

Field name	Type	Elements	Units	Description
tlCoordX	Unsigned int	1	n/a	Top left corner of the SMD box. Pixel index in azimuth.
tlCoordY	Unsigned int	1	n/a	Top left corner of the SMD box. Pixel index in range.
brCoordX	Unsigned int	1	n/a	Bottom right corner of the SMD box. Pixel index in azimuth.
brCoordY	Unsigned int	1	n/a	Bottom right corner of the SMD box. Pixel index in range.
quality	Unsigned char	1	n/a	Confidence measure for the find.

--	--	--	--	--

## 15 Tracking Information

This extension contains information about targets that were being tracked at the time of image formation. (Note: this extension can have a variable length, but does not use the variable length base class in section 13.)

**Table 27, Values of the Common Tag Structure for the Tracking extension.**

Field name	Default	Comments
systemID	“TRACKINFO”	Tag identifying this extension
versMajor	1	Main header major version
versMinor	0	Main header minor version
<i>unused</i>	0	<i>Reserved</i>
numBytes	4 + (numTracks * 40)	The first 4 bytes are used to hold the number of tracks (numTracks), while the remainder of the data holds the data for each track using the struct below.
<i>unused</i>	0	<i>Reserved</i>

**Table 28, Struct used to hold track data.**

Field name	Type	Elements	Units	Description
m_fPositionX	float	1	Long	Longitude of the target.
m_fPositionY	float	1	Lat	Latitude of the target.
m_fPositionZ	float	1	meters	Height above ellipsoid.
m_fVelocityX	float	1	m/s	Velocity of the target in the X dimension.
m_fVelocityY	float	1	m/s	Velocity of the target in the Y dimension.
m_fVelocityZ	float	1	m/s <sup>2</sup>	Velocity of the target in the Z dimension.
m_fAccelerationX	float	1	m/s <sup>2</sup>	Acceleration of the target in the X dimension.
m_fAccelerationY	float	1	m/s <sup>2</sup>	Acceleration of the target in the Y dimension.
m_fAccelerationZ	float	1	m/s <sup>2</sup>	Acceleration of the target in the Z dimension.

## 16 Future Header Extensions

---

Additional header extensions can be added at any time without incrementing the major or minor version numbers of the main header as long as they are preceded by appropriate values in the common tag structure. Values of *systemID* in the common tag structure should never be reused if a particular header extension is retired.

As mentioned previously, no attempt was made to define the contents of header extensions not used by current systems. The contents of these header extensions can be defined at a later date by the needs of the system that requires them. Some possible future header extensions are listed below:

- IFSAR
- Pass information